SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies for Enable Future Building Blocks in Space Exploration and Development (3)

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RESEARCH ON THE APPLICATION OF PHASE DIVERSITY TO LARGE APERTURE SPACE CAMERA

Abstract

Comparing with ground-based optical system, the environment for the optical system on-orbit is rather bad. Affected by the outer heat flux and inner heat source, the opto-mechanical structure will change with the temperature varying, which produces great temperature gradient to the mirrors and arise obvious optical aberrations. As a result, the imaging quality of the system will be impacted, which leads to lower resolution. The diameter of the early space optical system is small and separated from the outer space. So the thermal control is relatively simple. But, as the diameter of the optical system increases, the thermal control for the system is more and more difficult, and the thermal control actuating equipments are heavier and heavier. As we know, the mass is fatal to the spacecraft. Alternatively, adaptive optics, as a wave-front sensing and changing technique, is another way for improving the imaging quality of the space camera. It can reduce the difficulty of thermal control design. Even active thermal control design is unnecessary at all. Phase diversityas a candidate wave-front sensing and correcting technique in the field of adaptive opticsfirst proposed by Gonsalvesdetects phase aberrations from image data directly. It's based on the technique of image processing, mathematical optimization. It offers certain advantages over other wave-front sensors: the optical hardware required is simple to implement and it works well with extended scenes. In this article, firstly, the outer and inner heat flux varying with time for the optical system on-orbit is simulated. Secondly, the finite element analysis method is used to calculate the aberrations on the surface of the mirrors in the system. Then, the detecting system and imaging result is simulated. At last, according to the imaging result, using phase diversity, the aberrations for the optical system is calculated and the clearer image is restored. The results show that phase diversity can improve the imaging quality to be close to diffraction limit without active thermal controlling.